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ABSTRACT

New and innovative approaches to teaching in elementary schools are often advocated by university teacher education programs but fail to reach the actual classroom. This phenomenon was explored by interviewing graduates from the University of Utah elementary education program. These teachers were required to take two courses designed to prepare them to teach mathematics in elementary school. The first was designed to assist future teachers in gaining proficiency in the processes of mathematics as learners. The second helps them to learn how to teach mathematics to children. In these courses the approach has a process rather than a content orientation that asks the learner to engage in the activities of thinking, experimentation, problem solving, and verification with concrete models instead of mere memorization. The research into implementation of this teaching method had three aims: determine to what extent the graduates were using this approach in their classrooms; investigate the reasons why those who were only using the approach partially were not incorporating it in their teaching to a greater extent; and determine whether any differences existed in the responses made by teachers who had been teaching for different lengths of time. It was discovered that beginning teachers were inclined to use the teaching methods commonly in use in their schools rather than to innovate, but that teachers with more experience increasingly used the innovative approach they had learned at the university. The teachers revealed that while they understood, accepted, and valued the approach, and knew how to teach it to small groups of children, they were not taught how to organize and manage their classrooms so they could utilize it in their math programs. (JD)

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DROPOUT FACTORS IN THE PROCESS OF INFLUENCING CLASSROOM CHANGE THROUGH TEACHER EDUCATION

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DROPOUT FACTORS IN THE PROCESS OF INFLUENCING CLASSROOM CHANGE THROUGH TEACHER EDUCATION

Introduction

A continuing and critical concern of teacher education professors is the effect of pre-service teacher education on the practices of graduates, especially when the teacher training program advocates methods of teaching that are not commonly used in the public schools. It is the hope, if not the conviction, of most education professors that the attitudes, values, methods, and techniques taught in their university classes would, if implemented in the public schools, result in more valuable learning experiences for children. The results, however, have not always been encouraging, for the classroom practices of most beginning teachers are more apt to resemble those of the teacher next door than of the approaches professed by their university instructors.

Investigation of this phenomena has not been easy for researchers. The complexity of the teacher education process itself makes accurate assessment a formidable task as the factors involved are hard to isolate and identify for purposes of examining cause-effect relationships. Consequently, the reasons generally given as to why teacher education professors are or are not successful in changing the behavior of classroom teachers reflects, perhaps, more subjective speculation than objective investigation.

Recently, however, the authors became aware of a propitious situation within the elementary education program of the University of Utah in which to study the effects of an element of a teacher training

program on the classroom practices of teachers. The mathematics education portion of the program has, for some time, advocated a unique approach to the teaching of mathematics and appears to contain all the essential ingredients as well for bringing about changes in mathematics teaching. It was in this area that the research here presented was undertaken.

Background

Students graduating from the University of Utah Elementary Education Program are required to take two courses designed to prepare them to teach mathematics in the elementary school. The first course, Math 405 (The Real Number System) is designed to assist future teachers in gaining proficiency in the processes of mathematics as learners while Education 518 (Mathematics in the Elementary School) helps them learn how to teach mathematics to children. These courses are taught by Drs. Stanley Jencks and Donald Peck, members of the Department of Education Faculty, who advocate an approach to the learning of mathematics which is in contrast to that in current practice in most public schools. Essentially the approach (hereafter referred to as the Jencks-Peck Approach) has a process rather than a content orientation that asks the learner to engage in the activities of thinking, experimentation, problem solving and verification with concrete models rather than mere memorization. Both professors have devoted a good portion of their professional lives to studying, researching, and writing on the subject and have developed a clearly articulated approach to the teaching and learning of mathematics (Jencks and Peck, 1975; Jencks and Peck, 1968).

Furthermore, both faculty members are reputed to be excellent teachers; students have opportunities to experience the approach both as learners and as teachers; and most students seem to understand and accept it as a superior way of performing mathematics. Yet, general impressions of the elementary faculty as well as the mathematics instructors themselves indicated that the Jencks-Peck Approach was not being implemented to any great extent by graduates in their teaching.

Purposes

The purposes of this research were three-fold. The first was to determine to what extent graduates of the elementary teacher education program were using the Jencks-Peck Approach in the teaching of mathematics in their classrooms. The second was to investigate the reasons why those who were only using the approach partially were not incorporating it in their teaching to a greater extent. The third was to determine whether any differences existed in the responses to the factors made by teachers who had been teaching for different lengths of time.

Theoretical Considerations

A basic assumption of the study was that there would be a sufficient number of teachers who were using the Approach only partially or not at all to warrant investigation as to the reasons why the approach was not adopted more fully. It was reasoned that somewhere along the route from initial exposure to the Jencks-Peck Approach in Math 405 to the time when the teacher began teaching, there existed a number of obstacles or barriers, anyone of which might serve as a block to the implementation of the approach. These we chose to label "drop-out factors."

Initially we thought that these factors might be sequential and that passing or completing each would be a requisite for going on to the next. Had this been so, these factors would have been considered as "dropout stages," thus providing a temporal model for assessing points at which students could be judged as eligible or ineligible as potential implementers of the Jencks-Peck Approach. Subsequent theorizing suggested that this most likely would not be the case and that a student might likely skip one factor only to pick it up at a later stage out of sequence. Nevertheless, it seemed probable that all six factors must be met if the student was to use the Jencks-Peck Approach to any great extent. We assumed that no teacher would be required by the school system to use the Jencks-Peck Approach and that the decision to do so or not do so would be free from this kind of influence.

Dropout Factors

1. Knowledge and understanding of the basic concepts and principles of mathematics as taught by Jencks and Peck. A student may, because of laziness, lack of motivation, low intellectual capability, etc. never grasp the essence of mathematics from this point of view. Such a lack of understanding would preclude both subsequent success in the program as well as future implementation in the classroom.
2. Perception of the Jencks-Peck Approach as a personally valuable way to learn mathematics. A student, while understanding the approach and performing adequately in the processes might not see this method as being any better (and perhaps even less valuable) for him or her than the traditional

ones of memorizing formulas and computing answers to mathematical problems.

3. Belief that the Jencks-Peck Approach is one that could and/or should be used in teaching mathematics in the elementary school. Because of personal beliefs regarding the goals of mathematics education or ideas about the motivation or intellectual ability of elementary school aged children, a student might see the Jencks-Peck Approach as not suitable for elementary schools even though he or she may value it personally.

4. Attainment of a level of competency in teaching mathematics to children individually or in small groups using the Jencks-Peck Approach. Teaching this approach requires a somewhat unique set of attitudes and teaching techniques on the part of the student. For a number of reasons, he or she may not possess the basic personality, attitudes, or abilities to be successful in learning to teach the Jencks-Peck Approach.

5. Acquisition of the necessary skills for organizing and managing the classroom so that the Jencks-Peck Approach can be taught. Because this approach requires the teacher to teach children in a one to one or small group situation, the future teacher must learn to manage a classroom of 25 to 35 children so that he or she will be free to teach the Jencks-Peck Approach without losing control over the activities of the rest of the class.

6. Resistance by the school system to the implementation of the Jencks-Peck Approach when the student secures a teaching position. Curriculum mandates, pressures from the principal, supervisor, and other school people, and resistance from children and parents are all potential sources which may work to prevent the teacher from implementing such a mathematics program.

Procedure

A questionnaire was sent to 48 teachers who:

1. had taken both Math 405 and Education 518 with either Jencks and/or Peck in the previous 5 years, and
2. were currently teaching in an elementary school in one of three districts in the Salt Lake Valley, Utah.

Of the 48 questionnaires sent, 27 (56%) were completed and returned. The first 6 questions corresponded to the six dropout factors and the seventh dealt with the extent to which the Jencks-Peck Approach was being implemented.

Insert table I here

Respondents were asked to reply on a five-point scale with 1 indicating a generally low response and 5 a high. Space was provided for additional comments. Information regarding grade level and years of experience was also solicited.

Results

Table II shows the median responses for the 27 teachers on each of the seven factors of the questionnaire.

Insert table II here

The median response of 4.00 on a five point scale to factors 1, 2, and 4 indicated that teachers felt that they understood the fundamentals of mathematics (factor 1), that they valued the approach by which they were taught (factor 2), and that they had learned how to teach mathematics to small groups using the Jencks-Peck Approach (factor 4).

The median score of 3.00 on factor number 3 showed a division in terms of how well teachers felt the approach was applicable for use in a public school classroom. The response to this factor by teachers was very similar to their response to factor 7 which indicated the extent to which they used the method in their own teaching practice. It was speculated that the extent to which they saw the Jencks-Peck Approach as applicable was determined at least in part by the degree to which they were using the approach in their own teaching.

Teachers seemed to agree that what they had not learned in their pre-service teacher education program was how to organize a classroom of thirty or more students so that the small group approach required by the Jencks-Peck method could be used. The median score of 2 for factor 5 was the lowest of the median scores on the seven factors. The response to factor 5 was found to be significantly different from the response to factor 1 using the Wilcoxon matched-pairs signed-ranks test, ($T=4.5$, $p. < .001.$).

Responses to factor 6 (median score of three) showed that obstruction to the use of this innovative approach by the school system was

varied. In the comments to this item, some teachers said that they were told what methods to use in teaching mathematics. Yet the comments seemed to indicate that the reasons preventing the use of the method were due more to large classes and lack of time and materials. The responses to factor 6, therefore, seemed more related to lack of skill in organizing a classroom to teach using the Jencks-Peck Approach than to specific directives by the school system on how mathematics had to be taught.

Factor 7, with a median score of three, indicated that the approach was used moderately by teachers in their present teaching. Eight of the 27 teachers reported not using the approach at all and only one teacher reported using the approach fully. The pre-service teacher education program appeared to have some effect upon the way graduates teach mathematics but not as much as teacher educators would like.

Years in Teaching and Item Response. Because of the mixed responses on items 3, 6, and 7, it was decided to investigate whether the response to these items was related to teaching experience. The 27 respondents were divided into three groups: (1) those teaching for one year, (2) those teaching for two years, and (3) those who had taught between three and five years. Table 3 shows the median scores to items 3, 6, and 7 for each of the three groups.

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insert table III here

The responses to factor 3 indicated that the longer a person has taught, the more applicability the Jencks-Peck Approach was seen as having

for use in the elementary school. First year teachers (median=2.0) saw the approach as having some applicability and persons teaching from three to five years saw it as most applicable (median=4.0). Using the Mann-Whitney U Test, it was determined that the differences in medians of the first year and second year teachers was significant (U=17, $p. < .05$). The median difference between the group of first year teachers and the group that had been teaching for three to five years was also significant, (U=22, $p. < .05$).

Examination of the response of the three groups to factor 6 showed that the group with more teaching experience saw less restriction placed upon their teaching of mathematics (median=2.0) than either second (median=2.5) or first year (median=4.0) teachers. Again the Mann-Whitney U Test was used to determine if the median differences were significant. The differences between the first year and the second year teachers was significant, (U=10, $p. < .05$). The differences between first year teachers and teachers who had been teaching from three to five years was also significant, (U=18, $p. < .05$).

A study of responses to item 7 indicated that experienced teachers were more likely to use the Jencks-Peck Approach than were teachers in their first year of teaching. The difference in median between the first year and second year was significant, (U=14, $p. < .05$) and there was a significant difference between the medians of the first year teachers and those teaching from three to five years, (U=15, $p. < .05$).

Correlation Between Dropout Factors and Use. A major question considered was whether the response of teachers to the six dropout

factors (items 1 through 6 on the questionnaire) were related to teachers reported use of the Jencks-Peck Approach in teaching mathematics (item 7). A Spearman rank order correlation was computed to determine this relationship, (rho=.77). This correlation was significant, ($t=6.09$, $p. < .0005$). The moderately high correlation indicated that the six dropout factors in the questionnaire did account for a considerable proportion of the variance in terms of the extent to which the Jencks-Peck Approach was used by classroom teachers. This made it possible to assume that the dropout factors used in the questionnaire were critical factors in determining whether or not the mathematics methods learned during pre-service teacher education were used during the teaching career of the graduate.

Written Comments. Written comments generally supported the numerical rating made on each factor. Several comments described why the mathematics courses at the university were seen as successful. The following is representative: "It helped me learn to use my reasoning ability, to understand the theory behind a problem and not just the process of solution." Several teachers commented on the fact that they were initially afraid of mathematics and their experiences in the teacher education program had shown them that they could understand the subject matter and help children to learn.

Most of the negative comments were in terms of the problems associated with using the Jencks-Peck Approach in regular sized classrooms. A typical response was, "I've tried it. However, it's impractical for a 35 student classroom." Others criticized the teacher education program because it hadn't helped them learn how to organize their classroom

so that individual or small group instruction could be carried out. One teacher expressed this clearly when she wrote, "I didn't find any class in the education program that taught me how to organize any part of a total classroom."

Conclusions and Implications

This study gives support to the concept of the 6 dropout factors as a viable framework for investigating the reasons why skills, values, and knowledge taught in a pre-service teacher education program might not reach classroom implementation. By altering the wording of the questionnaire, data could be gathered on the effects of teacher education on classroom practice in other areas of the curriculum as well, such as science, language arts and social studies. Potentially, the concept of the 6 dropout factors could provide a powerful tool for identifying and isolating program gaps and weaknesses.

The survey did indeed identify an area of weakness in the mathematics education portion of the University of Utah teacher education program. Classroom teachers revealed, both in the factor ratings and in their comments, that while they understood, accepted and valued the approach, and even knew how to teach it to small groups of children, they were never taught how to organize and manage their classrooms so that they could utilize it in their math programs. This implies that the University has not paid sufficient attention to the realities of the public school classroom and especially the difficulty in organizing large numbers of children so that the direct teaching could occur individually and in small groups. While there is an increased emphasis upon field experience in the teacher education curriculum, the methods

courses perhaps still focus too much upon ideal classroom situations and not enough help is given to prospective teachers on how to organize so that small group teaching methods can be used within classrooms containing large numbers of children.

The effects of teaching experience on responses to the questionnaire, especially items 3, 6, and 7, was not expected and raises a number of interesting questions about when teachers might use the knowledge and skills they learn as they prepare to become teachers. First year teachers may be too concerned with the issue of survival in the classroom to use any approach that might be considered innovative either by other faculty in the school or by the children they are teaching. Only as teachers become more secure in their ability to manage classrooms and meet the expectations of the school system are they likely to be ready to experiment with more effective ways of teaching any content area.

A somewhat surprising but interesting finding of the survey was that while the school districts in this study were not reported as providing special support for innovative programs in mathematics, neither did a great deal of opposition exist to prevent teachers from using methods they deemed effective and appropriate. This suggests that instead of assuming that the school system is the sole culprit in preventing innovation and change, teacher educators might very well look to their own programs as a source of trouble. If new and more effective ways of teaching are to bear fruition, it appears that teacher educators must, in addition to presenting the best teaching approaches currently known, help prospective teachers learn to implement these approaches within the complexities of the actual classroom.

Citations

Jencks, Stanley and Peck, Donald. "Symbolism and the World of Objects." The Arithmetic Teacher, May 1975, Vol.22. No. 5, pp. 370-371.

Jencks, Stanley and Peck, Donald. Building Mental Inquiry in Mathematics. New York: Holt, Rinehart and Winston, 1968.

Table I

Questions Included on the Teacher Questionnaire

1. How well do you think you learned and understood the math concepts taught in Math 405 and Education 518?

   Not very well 1 2 3 4 5 Very well

2. To what extent do you think the approach to learning math as taught in Math 405 and Education 518 was of more value to you as a learner than other ways you've experienced?

   Little value 1 2 3 4 5 Great value

3. To what extent do you think the approach to learning math as it was taught in Math 405 and Education 518 is applicable in the elementary school?

   Little applicability 1 2 3 4 5 Fully applicable

4. Assuming you could work with children in small groups like those you worked with in Education 518, how well do you think that course prepared you to teach math to children?

   Not very well 1 2 3 4 5 Very well

5. As a result of your university training, how prepared were you to organize your total classroom to incorporate a math program as taught in Education 518 into the total curriculum?

   Minimally prepared 1 2 3 4 5 Very well prepared

6. To what extent does the public school system in which you work prevent you from putting into operation a math program as taught in your university teacher education program?

   Little interference 1 2 3 4 5 Highly restrictive

7. To what extent do you believe you are using a math approach as taught by Jencks and Peck in the Math 405 and Education 518 courses you took at the University of Utah?

   Very little 1 2 3 4 5 Fully

Table II

Median Scores-Dropout and Implementation Factors

	Factors	N	Median Score
1.	Understanding of Concepts	27	4.00
2.	Perceived Value	27	4.00
3.	Belief in Applicability	27	3.00
4.	Teaching Competency	27	4.00
5.	Classroom Management Skill	27	2.00
6.	School Resistance	27	3.00
7.	Degree of Implementation	27	3.00

Table III

Median Scores of Teachers on Factors 3, 6, and 7 as Related to Years of Teaching Experience

	Factors	Median score 1st year Teachers N=10	Median score 2nd year Teachers N=8	Median score 3rd to 5th year Teachers N=9
3.	Belief in Applicability	2	3	4
6.	School Resistance	4	2.5	2
7.	Degree of Implementation	1.5	3	3